DSM2UG

California Department of Water Resources | Delta Modeling Section

2011 Annual Report

Ralph Finch, Senior Engineer WR, DWR

The following are brief summaries of modeling work conducted during 2010-2011, which is presented in the 2011 Annual Report. The Report has been approved for publication and will be available soon.

Chapter 1 — Improvements to DSM2 Qual: Part 1

An important property of numerical models is that the simulation gets better as time and spatial steps are refined, with the model eventually "converging" to a solution determined by the underlying physics and equations. In qualitative testing, Delta Simulation Model II-Water Quality Model (DSM2-Qual) was found to converge slowly and to exhibit erratic behavior with very small (1 minute) steps. The poor qualitative convergence results from 2 ad hoc features of the code: parcel recombination in the Lagrangian advection scheme and a spatially dependent mixing scheme for dispersion. Corrections are proposed here to minimize both problems. Tests show that with these changes, DSM2-Qual's qualitative convergence is much improved.

Chapter 2 — Improvements to DSM2-Qual: Part 2

This chapter documents tests of DSM2 Version 8.0.5. The Bogacki-Shampine algorithm was implemented in the non-conservative constituent model to avoid negative value problems in the old solver. Also in Version 8.0.5, the user can set the minimum dispersion velocity to avoid zero-dispersion problems at dead-end channels/closed gates.

Chapter 3 — DSM2 Dissolved Organic Carbon Boundary Condition Improvement

In this chapter, the dissolved organic carbon data collected from the East Side Streams and Yolo Bypass are summarized, and comparisons are made between the collected data and the assumed boundary conditions of the DSM2. Based on these comparisons, the assumed boundary conditions for DOC concentrations may underestimate concentrations during high flows.

Chapter 4 — South Delta Temporary Barriers Hydrodynamic Modeling

This chapter presents an abbreviated sample of the simulation of historical 2008

Delta hydrodynamic conditions and the effect of the installation and operation of the south Delta temporary barriers. For this analysis, historical Delta inflows, consumptive use, and exports were simulated under 2 barrier conditions: (1) historical 2008 installation and operation of the temporary barriers, and (2) no installation of south Delta temporary barriers. DSM2-Hydro was used to simulate the Delta hydrodynamics.

Chapter 5 — Adaptive Mesh, Embedded Boundary Model for Flood Modeling

This chapter describes a 2-dimensional shallow water model designed to simulate water quality and flooding. The model uses a finite-volume discretization of the shallow water equations on an adaptive Cartesian mesh, using embedded boundaries to represent complex topography. The model is tested using analytical solutions of flood propagation on wet and dry channels and of a dam-break problem. Applications to flooding in arbitrary bathymetry are discussed.

Chapter 6 — Using Software Quality and Algorithm Testing to Verify a One-Dimensional Transport Model

In this chapter, we describe our approach and experiences developing a software verification framework for a one dimensional (1-D) transport model of advection, dispersion, and reactions or sources (ADR). The testing framework described was developed as part of a project to create a new transport module for the DSM2, a 1-D hydrodynamic and transport model for flow and water quality in the Delta. Our target problems include river and estuary advection, and 1-D approximations of common mixing mechanisms and source terms associated with conservative and non-conservative water quality kinetics including sediment transport.

Chapter 7 — Turbidity Modeling with DSM2

This chapter documents turbidity modeling with DSM2 Version 8.0.6. Turbidity has been deemed to be an important factor affecting delta smelt migration and entrainment. DSM2 is a promising tool in turbidity analysis and forecasting because of its speed as a 1-D model and its extensive applications in the Delta. A large number of stations with turbidity data became available in 2010, which makes a more detailed calibration possible for the 2010 wet season. The calibrated DSM2 model results generally match with the observed data. Further validation with another wet year will help improve its reliability.

Chapter 8 — DSM2 Grid Map Tool

DSM2 physical geometry is represented by channel lengths, channel cross sections, reservoir areas, and reservoir bottom elevations. These inputs are derived from geographical data, which are now available in computer systems and referred to as Geographical Information Systems (GIS).

Since 1998, DSM2 geometry has been handled with the Cross-Section Development Program. The project described in this chapter offers all the capabilities of CSDP and several more, and may serve to replace CSDP for DSM2 bathymetry and channel development. The application is built on the Google Maps API and is designed to be used within a modern web browser. The data is hosted online for ease of accessibility for a wide audience of users and to support the large datasets required to provide the elevation functionality.

Chapter 9 — DOC Validation with DSM2

Using DSM2, historical Delta DOC was simulated over the period 1990 through 2010 and compared to available measured data. DOC fingerprints were generated at several locations to evaluate how contributions of various sources of DOC in the Delta vary by location. This chapter summarizes the methods and results from an expanded DSM2 simulation of historical Delta DOC.

Chapter 10 — DSM2 Comparison Report Tool

While running DSM2 for different scenarios, knowing the changes that have been made to input files and subsequent changes to DSM2 outputs is essential for model investigation. Analyzing DSM2 model input and output changes with existing tools involves manual steps that are cumbersome and inefficient. The objective for the tool development described in this chapter is to automate the comparison process. The goal is to reduce duplicate effort and human errors, and provide a systematic way for study comparison.

Upper Jones Tract Levee Breach and the Nutrient Model – A Confession and an Update

Marianne Guerin, Senior Water Resources Specialist, RMA

A levee on the southwest side Upper Jones Track failed on June 3rd, 2004 allowing water to flood both Upper Jones Tract and Lower Jones Tract to the north. After flooding, the exchange of water and nutrients between the submerged island and Middle River continued until the breach was filled. Subsequently the water was pumped out of both Upper and Lower Jones Tract into Middle River, delivering an interesting mixture of water quality constituents into Middle River.

Confession: In the process of updating the QUAL nutrient model calibration for Version 8.0.6, I discovered that I had previously neglected to set nutrient concentrations for the flows involved in the 2004 Jones Tract levee break.

Update: Luckily, MWQI and Ted Swift came to my rescue in the form of a very through report entitled “Jones Tract Flood Water Quality Investigations” (July 2009) plus data used to create the plots in the report – Thanks Ted! Chapters 3.1 and 3.4 supplied most of the information I needed for a pretty good set of boundary conditions. The levee break is split into two main periods in DSM2 – the time from the levee break (June 3rd, 2004) until the break was closed (June 30th), and the pump-out period (June 12th through December 18th).

Data availability for nutrients and temperature was mixed. Automated water quality sondes collected continuous data for part of this period at a couple of locations – these supplied a partial time series of 15-minute temperature and DO data. Before and after the sondes were operational, grab sample data was used to create the BC for all constituents. When data wasn’t available, too sparse to create a decent time series, or questionable once water levels became very low in the island, I used constants as boundary conditions. A single set of BC was developed for application during both periods (i.e., before and after filling the breach).

Figure 1 shows BC for two of the constituents – water temperature and Chlorophyll a (used to set Algae). Figures 2 – 3 illustrate a few of the differences in water temperature and concentration of Algae in nearby locations in a simulation run without and with the Jones Tract breach implemented in HYDRO and QUAL. A more complete analysis of the differences, and illustration of the boundary conditions, will be included in the nutrient model documentation I am currently revising for the State Water Contractors, under the direction of Paul Hutton of MWD.

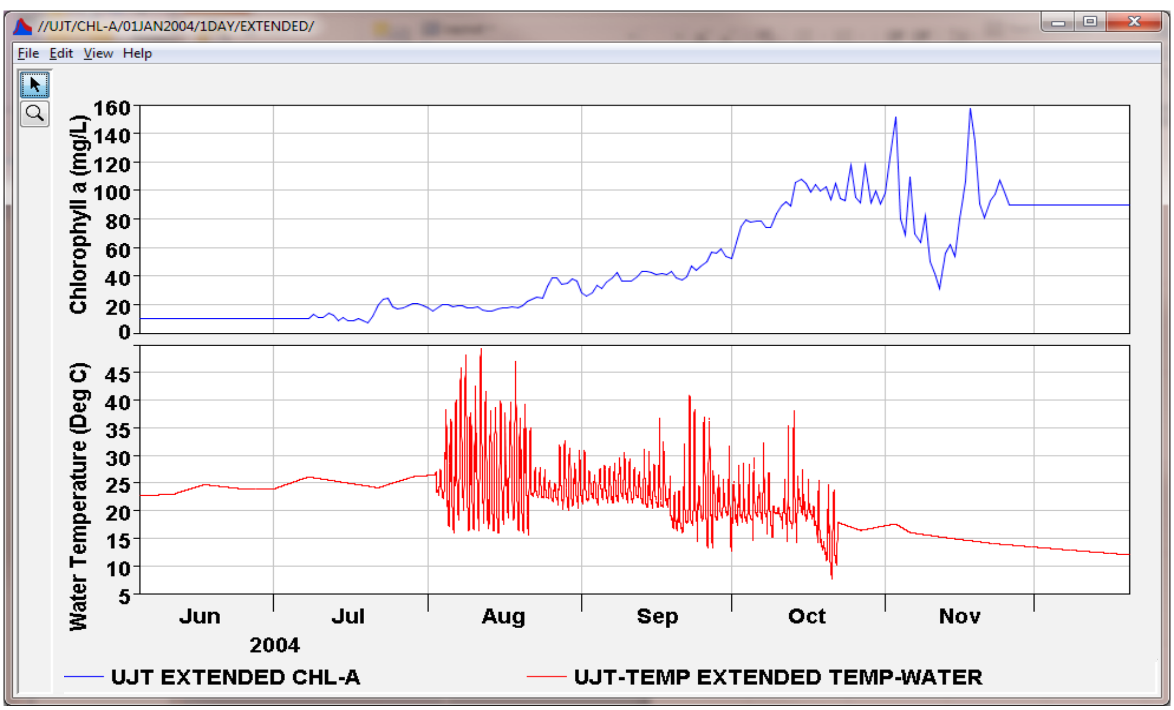


Figure 1. Composite data used to create BC for water temperature and chloropyll a in QUAL – the latter is converted to the variable “Algae” used in QUAL.

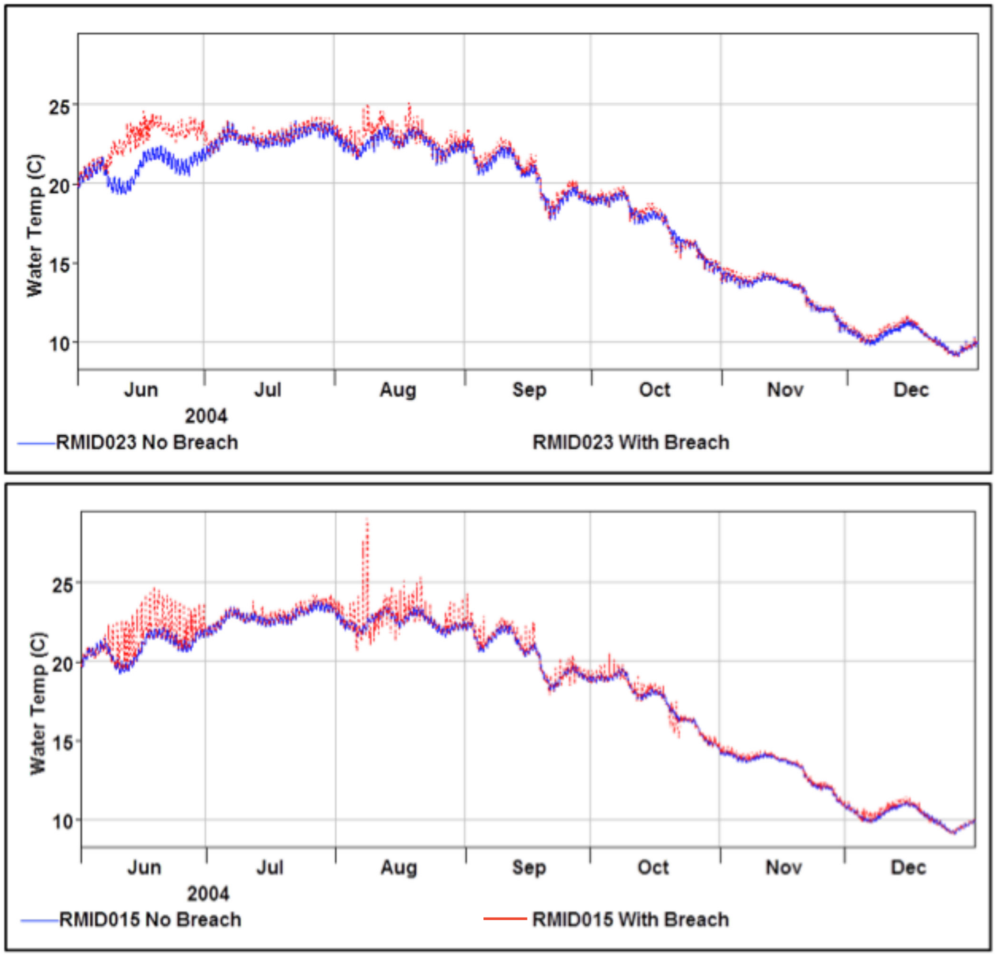


Figure 2. Middle R. water temp. above & below the breach without and with the levee break simulated in DSM2.

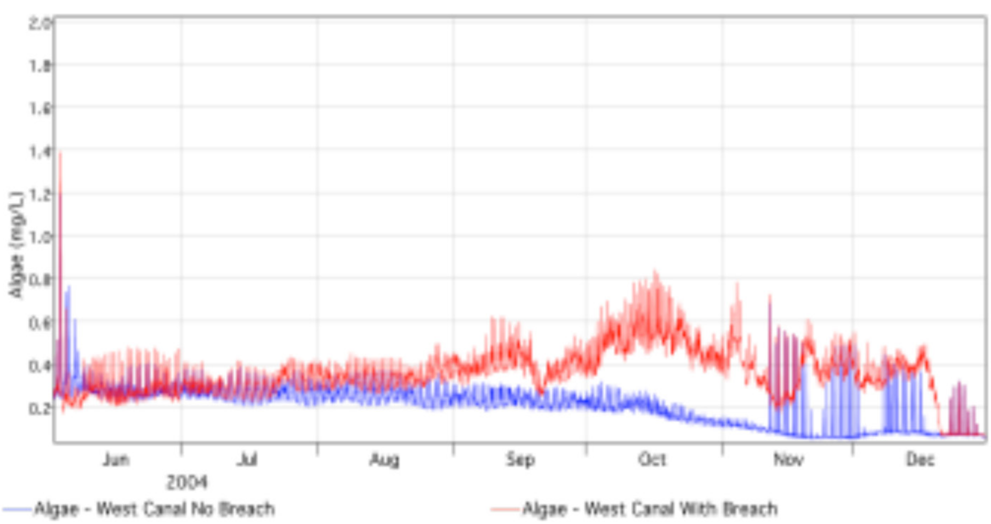


Figure 3. Concentration of Algae in West Canal without and with the levee break simulated in DSM2.

DSM2 V8 Update

Nicky Sandhu, Senior Engineer, DWR

DSM2 V8.1 development is underway. The two major developments are:

Improved dispersion formulation. This is the work done by Lianwu Liu[1] that improves the dispersion formulation such that it is independent of time step. The work done suggests using 5 min hydro time step with a 15 min tidefile output from hydro and running qual at 5 min time step.

Qual output as a HDF5 file with average concentration for each channel and reservoir, as well as concentration at the upstream and downstream of each channel at interval specified in the input files. This qual binary output data can be read by Vista and can be scripted using Jython as well. This opens up the possibility of developing animation and/or analysis tools based on this information in the future.

Minor improvements include:

Any bug fixes found since version 8.0.6

PTM fixes and improvements based on recent testing

Lianwu Liu and Eli Ateljevich, Improvements to the DSM2-Qual Part 1, *Methodology for Flow and Salinity Estimates in the Sacramento-San Joaquin Delta and Suisun Marsh, 32nd Annual Progress Report, June 2011.*

Delta Cross Chanel

Dispersion Recalibration with DSM2 Version 8.1.1

Lianwu Liu, Engineer WR, DWR
Nicky Sandhu, Senior Engineer WR, DWR

Version 8.1 improved the dispersion formulation to make the model convergent with respect to time step and parcel size (Liu & Ateljevich 2011). A new dispersion coefficient (DC) was introduced. A limited dispersion recalibration is done in this study.

This calibration is based on the 2009 BDCP Calibration grid by CH2M (CH2M Hill 2009). The 2009 Calibration by CH2M was done using DSM2 Version 6. The calibration period was from 10/1/2000 to 10/1/2008. This recalibration by version 8.1.1 is done by scaling the previously calibrated dispersion coefficients globally, without fine tuning, and using the same calibration period. The best result was obtained when new coefficients (DC) were calculated/scaled by 1425, i.e. DC=1425*DQQ. This approach works because the improved dispersion formulation is closely correlated to the original formulation (both versions scaled dispersion with discharge Q).

The metric used to evaluate the model performance include: Linear regression analysis of monthly-averaged EC. This scatter plot with a linear regression trend line shows the simulated vs. observed monthly averaged EC. The intercept is set to zero so that the slope shows the bias of the model. The model is overpredicting when the slope is higher than 1, and underpredicting when the slope is smaller than 1. R2 value gives information about the goodness of fit of the model. A high R2 value close to 1 means best fit, which usually means high quality data and good model prediction.

- Timeseries comparison of monthly-averaged EC. This plot compares modeled and observed EC month by month, easy to see directly which months the model is doing well or bad.
- Timeseries comparison of daily-averaged EC. This plot compares modeled and observed EC on a daily basis, and easy to see how the model is doing over all.
- Mean Error (ME) and Percent Mean Error(PME). The mean values of observed and modeled EC for the entire calibration period are calculated. Percent Mean Error is calculated using Mean Error divided by the observed mean. This gives a normalized percentage how much the model is overpredicting or underpredicting.
- Root Mean Squared Error (RMSE) and Relative RMSE. RMSE is calculated based on daily averaged data. It is a good indicator of model prediction error and representative of the size of a "typical" error. The relative RMSE (also called normalized RMSE, or percent RMSE) is calculated as RMSE divided by the range of the data and expressed in percentage.

These different statistical measures usually act in unison. The model that is good at one measure usually is good at others. On the other hand, any bad value reveals weakness. Putting them together shows a more complete picture about the quality of the model.

Figures 1 to 6 show the comparison of simulated EC with observed data and 2009 calibration (run by v8.0.4) at key stations: Collinsville, Emmaton, Jersey Point, Old River at Bacon Island, Clifton Court Forebay, and Montezuma Slough at Beldons. In 2009 calibration, the simulated EC is low at most of the stations (regression slope <1). The predicted EC in this calibration is generally higher than in 2009 calibration and improved significantly at Bacon Island and Clifton Court.

The modeled EC at Jersey Point tends to be higher than the field data, and lower at Clifton Court Forebay and Montezuma Slough. This bias is similar to the 2000, 2009 calibrations. Version 8.1 has some improvement over Version 8.0, but the bias is still large. Trial runs to fine-tune dispersion coefficient showed very limited effect to improve the calibration. The coefficients were already tuned to extreme to lower this bias.

Altogether 24 stations with good CDEC data are selected and plotted (not included in this news letter). Mean Error, Percent Mean Error, RMSE and relative RMSE are calculated and listed in Table 1.

From Table 1, Emmaton, Old River at Bacon Island, and Jones Pumping Plant have the smallest Percent Mean Errors within 3%. Usually there is no absolute number or criteria for a "good" value of these statistical measures. From Table 1, we can see stations at which Percent Mean Errors are less than 10% are those stations with better agreement, where Percent Mean Errors are bigger than 10% are not good. Similarly Relative RMSE values less than 10% can be considered reasonable, while larger than 10% are not good.

The model consistently underpredicts San Joaquin River stations (RSAN072, RSAN058) and South Delta stations (ROLD059, CHGRL009, RMID027,RMID040). The worst is Old River at Tracy Road (ROLD059) with percent mean error -22.2% and Relative RMSE 15.0%. A lot of reasons might contribute to the errors in calibration, e.g. bathymetry, DICU, boundary flow and water quality measurement errors, etc. A full calibration may address some of these issues.

Table 1. Mean Error and Root Mean Square Error at Selected Stations

Location	DSM2 Station	CDEC Station	Mean (umhos)				RMSE (umhos)	Relative RMSE (%)
			Observed	Simulated	Error	%		
Sac River at Port Chicago	RSAC064	PCT	8968	9666	698	7.8	2846	12.4
Sac River at Collinsville	RSAC081	CLL	2971	3181	210	7.1	840	6.9
Sac River at Emmaton	RSAC092	EMM	687	708	21	3.0	306	6.1
Sac River at Rio Vista	RSAC101	RIV	187	201	13	7.2	57	8.0
Three Mile Sl at Sac River	3MILE_SL	TMS	481	541	60	12.4	220	6.8
SJR at Antioch	RSAN007	ANH	1915	2058	144	7.5	618	7.6
SJR at Jersey Point	RSAN018	JER	703	772	70	9.9	271	8.3
SJR at San Andreas Landing	RSAN032	SAL	225	274	49	21.8	89	14.7
Stockton Ship Channel	RSAN058	RRI	599	528	-71	-11.9	117	11.5
SJR at Brandt Bridge	RSAN072	BDT	528	487	-42	-7.9	67	6.6
SJR at Mossdale	RSAN087	MSD	530	509	-21	-4.0	75	7.5
Dutch Slough	SLDUT009	FRP	584	609	26	4.4	173	10.8
Old River at Holland Cut	ROLD014	HOL	464	425	-39	-8.5	76	8.7
Old River at Bacon Island	ROLD024	BAC	365	374	9	2.5	93	11.6
Middle River near Holt	RMID005	HLT	313	350	37	11.8	52	13.9
Middle River at Borden Hwy	RMID023	VIC	352	359	7	2.1	60	5.9
Middle River at Tracy Blvd	RMID027	MTB	518	454	-64	-12.4	155	11.2
Middle River at Mowery Bridge	RMID040	UNI	618	586	-32	-5.2	74	7.1
Old River at Tracy Road	ROLD059	OLD	639	497	-142	-22.2	173	15.0
Grant Line Canal at Tracy Blvd Bridge	CHGRL009	GCT	598	518	-80	-13.4	109	10.8
Banks Pumping Plant	CLIFTON COURT	HBP	407	386	-21	-5.1	53	8.3
Jones Pumping Plant	CHDMC006	DMC	444	432	-12	-2.7	66	8.0
Montezuma Slough at Beldons	SLMZU011	BDL	6838	5886	-952	-13.9	1539	8.4
Montezuma Slough at National Steel	SLMZU025	NSL	5451	4683	-768	-14.1	1425	9.6

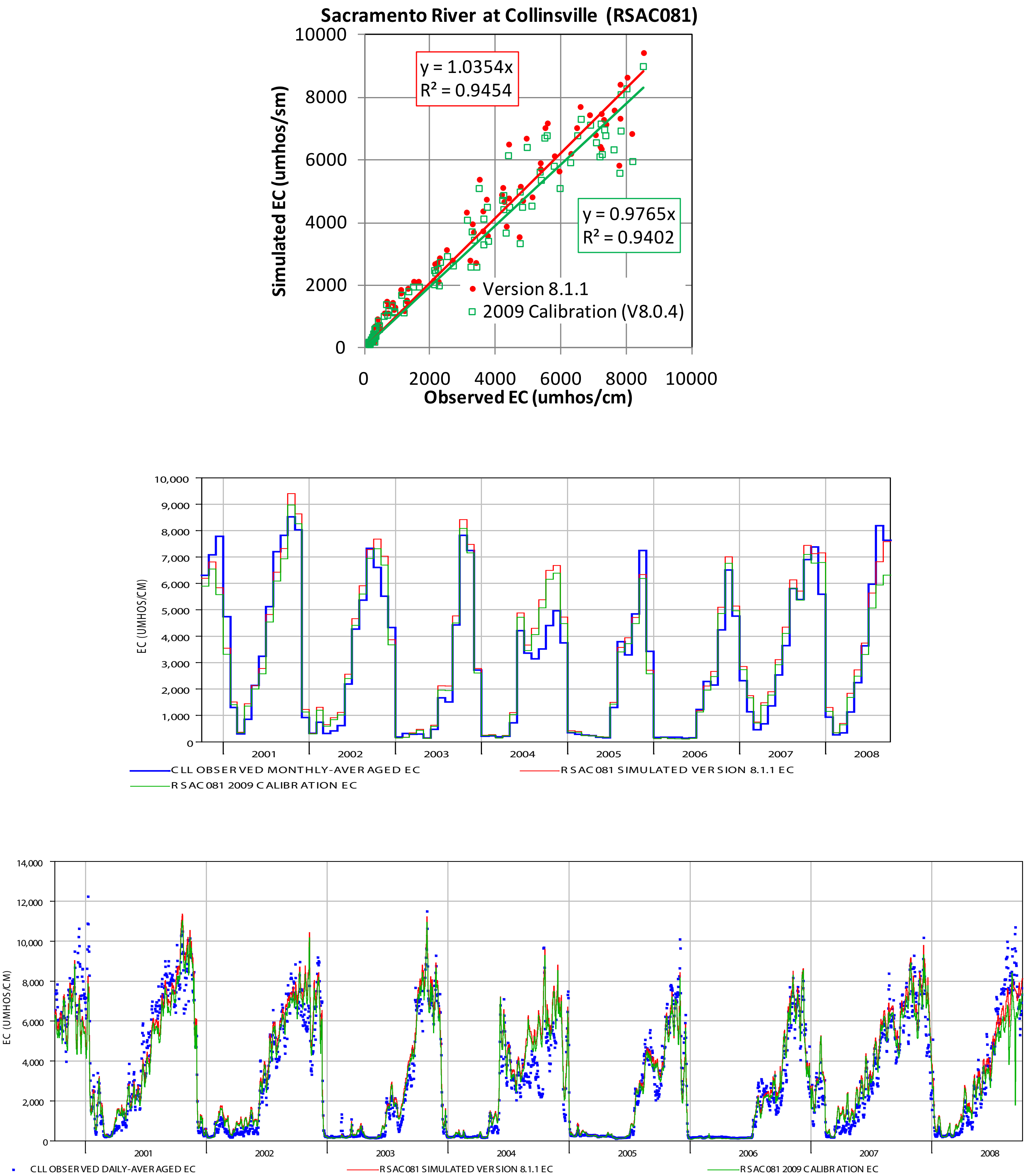
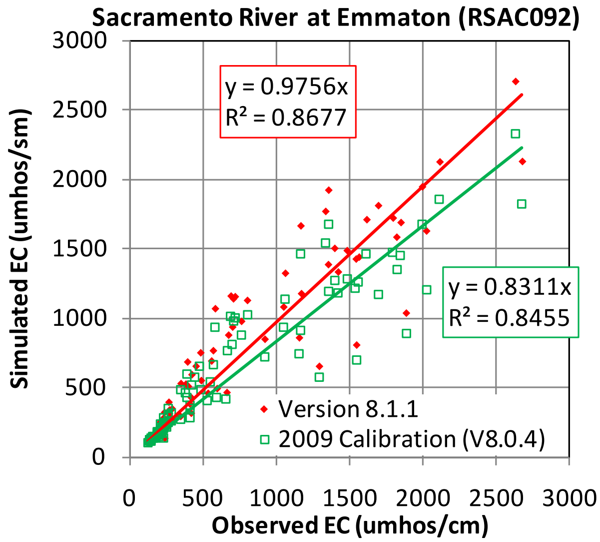
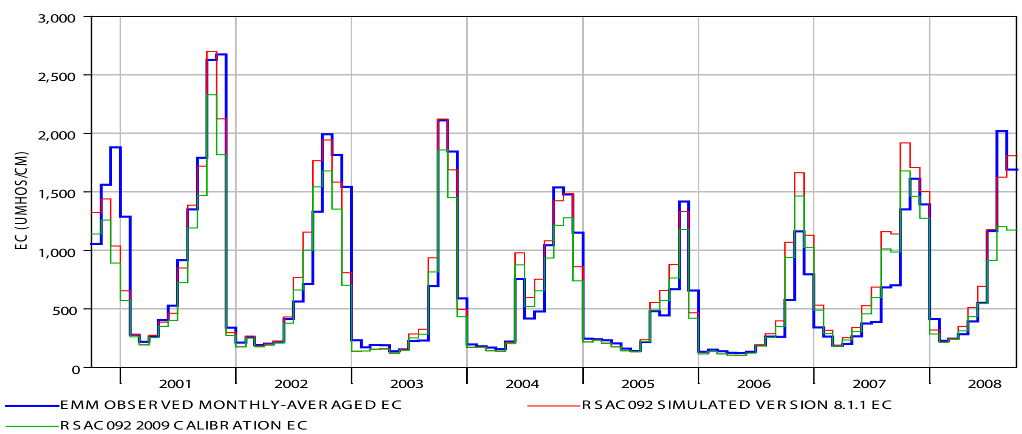


Figure 1. Sacramento River at Collinsville (RSAC081)





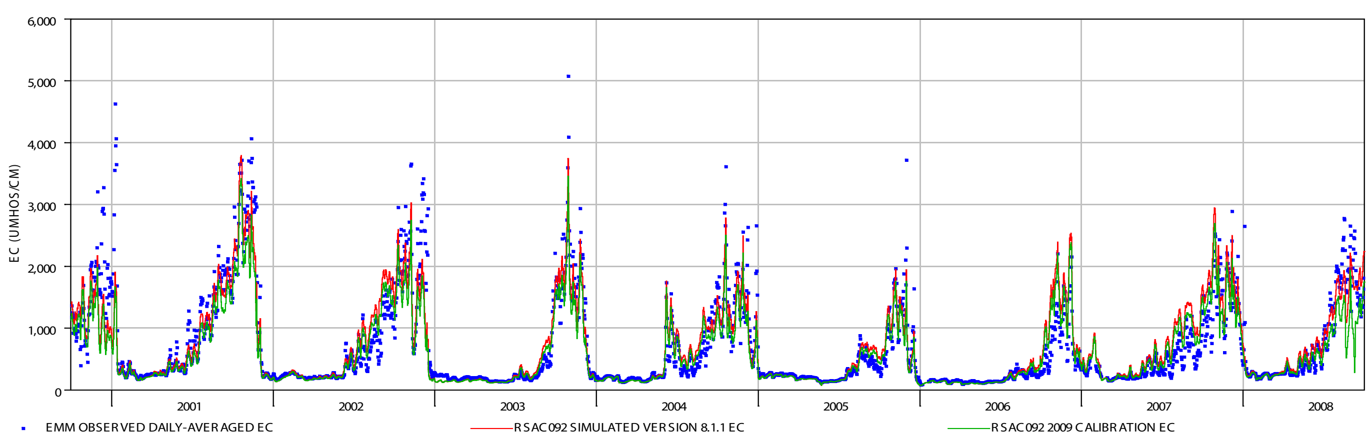
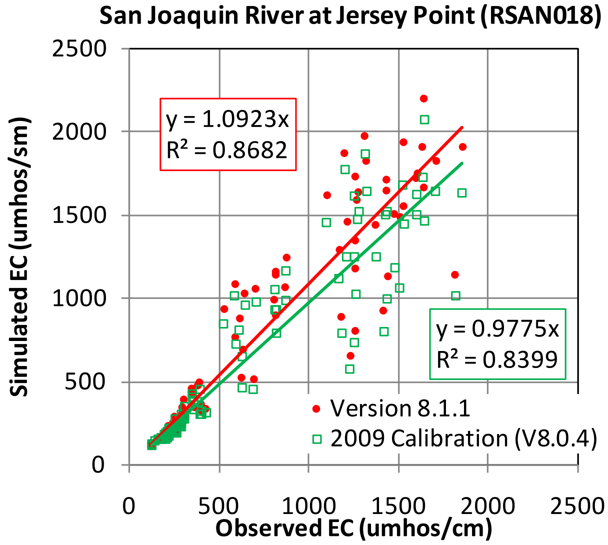
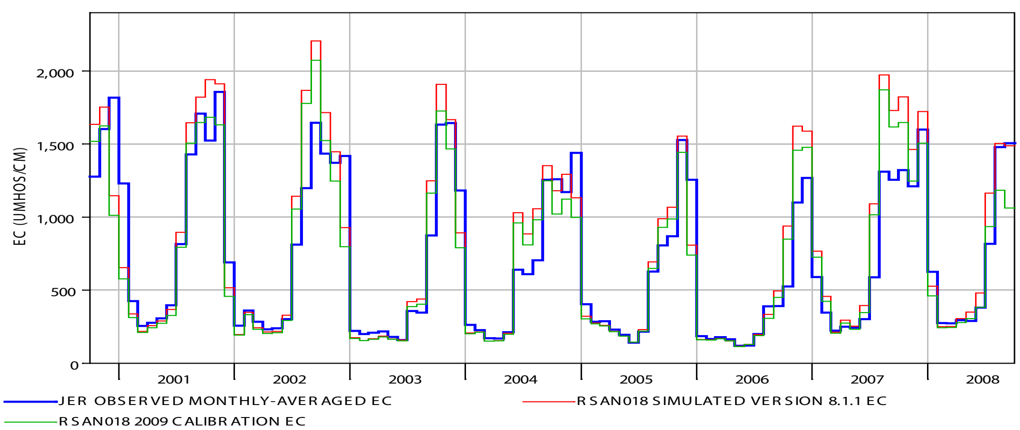


Figure 2. Sacramento River at Emmaton (RSAC092)





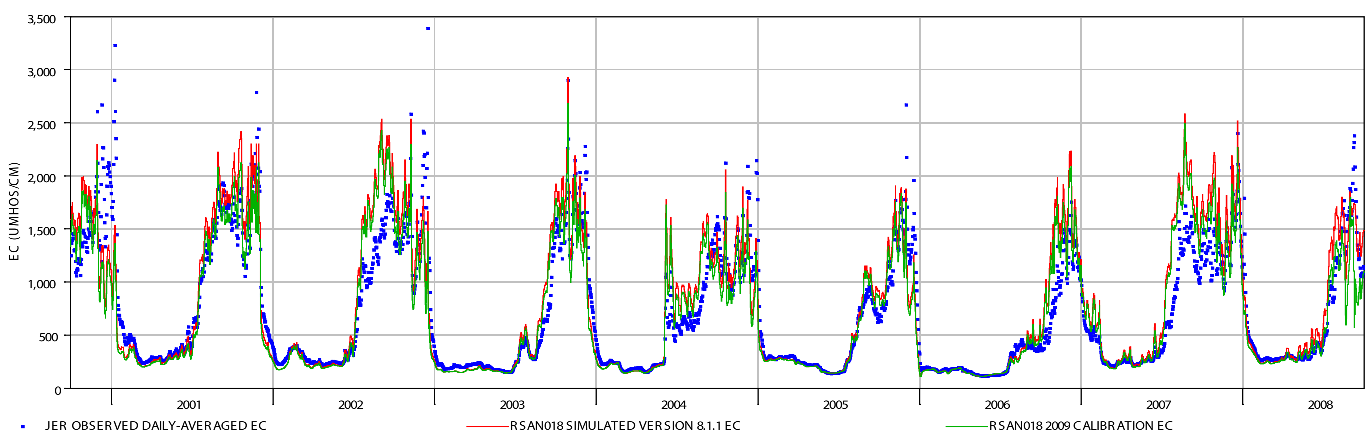
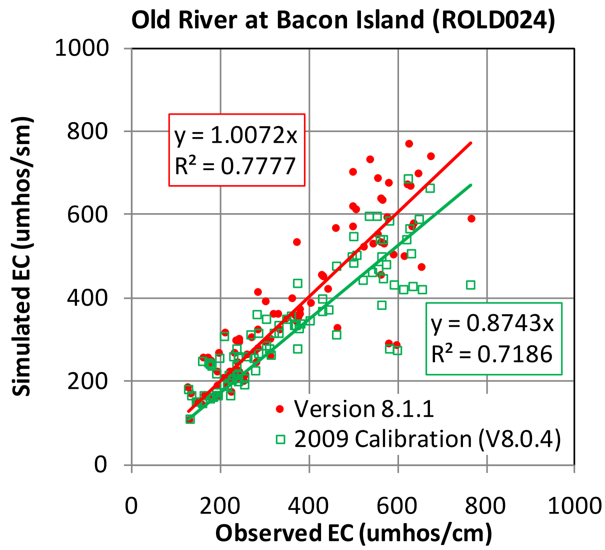
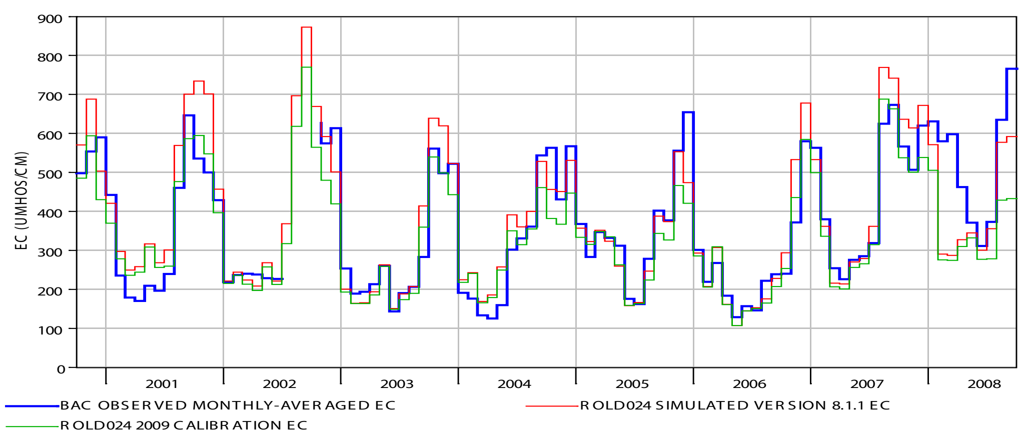


Figure 3. San Joaquin River at Jersey Point (RSAN018)





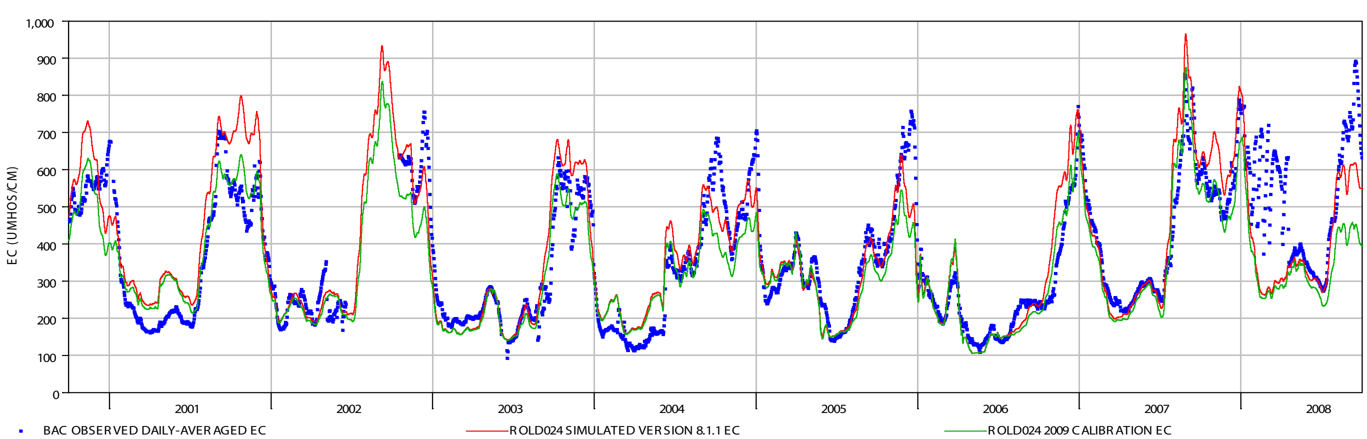
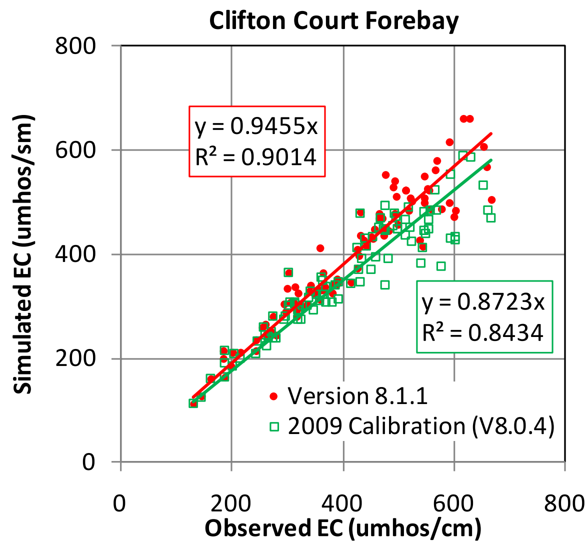
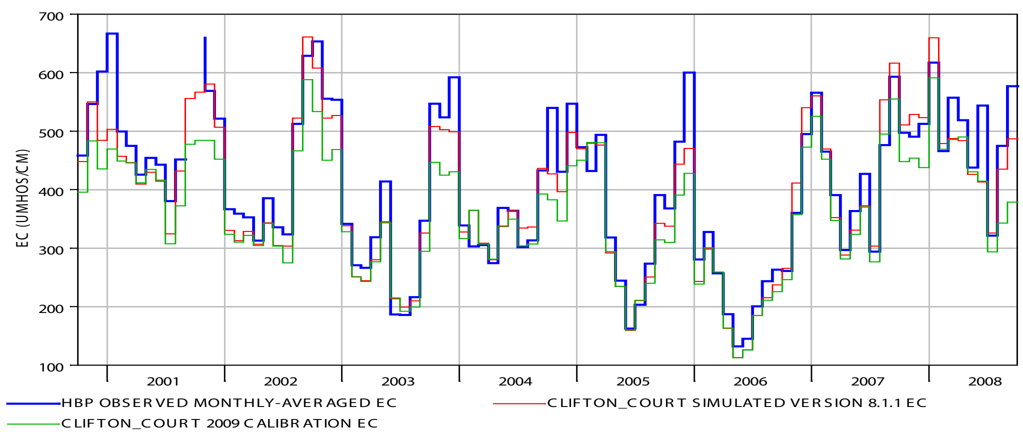


Figure 4. Old River at Bacon Island (ROLD024)





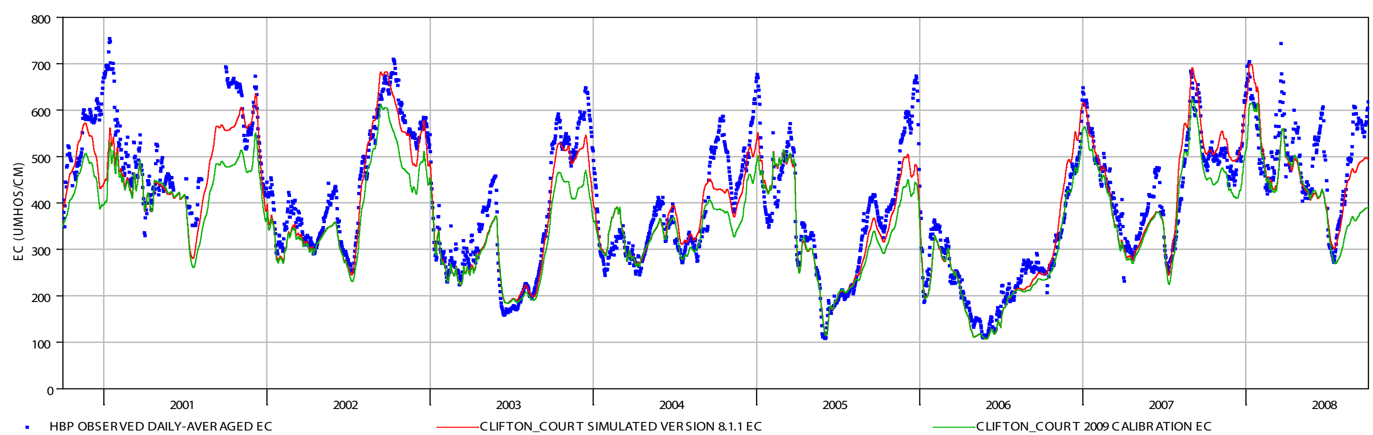


Figure 5. Clifton Court Forebay

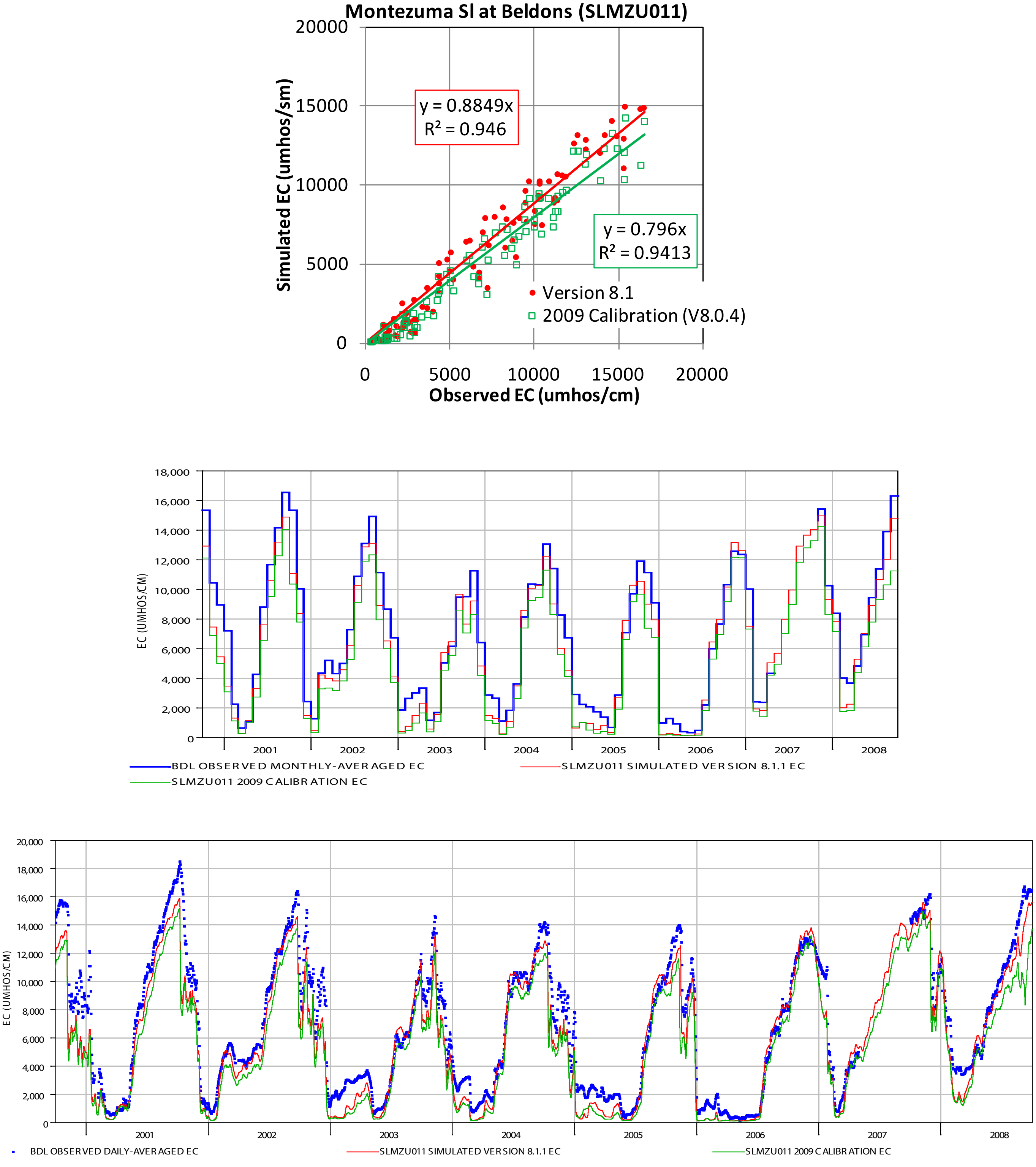


Figure 6. Montezuma Sl at Beldons (SLMZU011)

Discussion of Model Limitation

1. The simulation misses EC peaks almost every year at Clifton Court, similarly at Jersey Point and Antioch, as seen in Figure 7. It shows these peaks are caused by salinity from Martinez. The model couldn't reproduce these peaks. The main reason may be due to simulated flow error. Another reason contributing to this problem maybe the dispersion model is not good enough to reflect the dispersion changes caused by flow change. As shown in Figure 8, the model generally overpredicts in the summer at Antioch and Jersey Point, underpredicts around December when observed EC peaks.

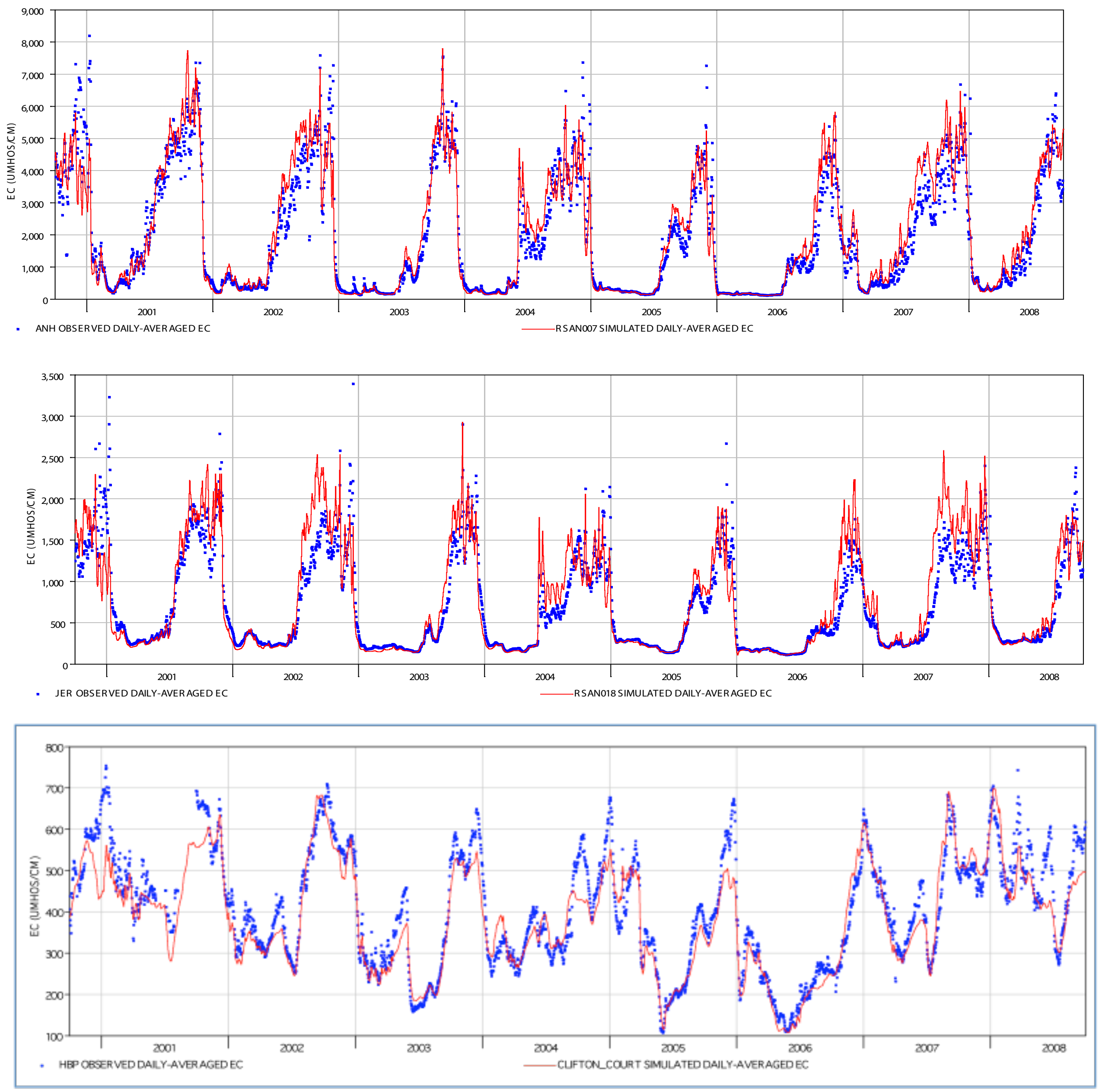
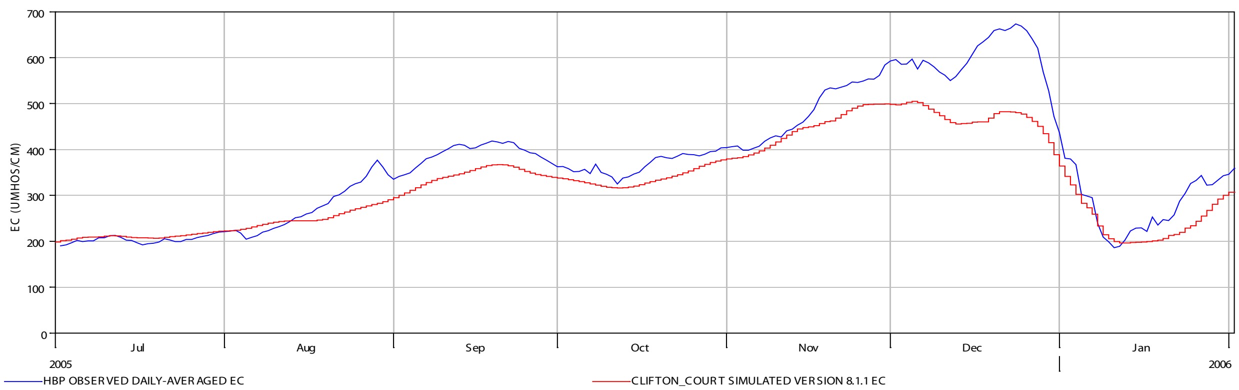
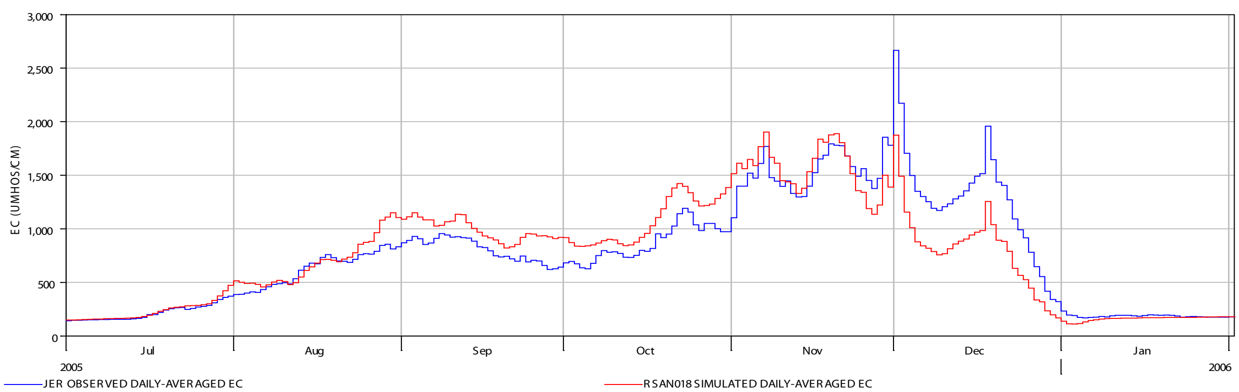


Figure 7. Comparison of missing EC peaks at Clifton Court, Jersey Point, and Antioch.





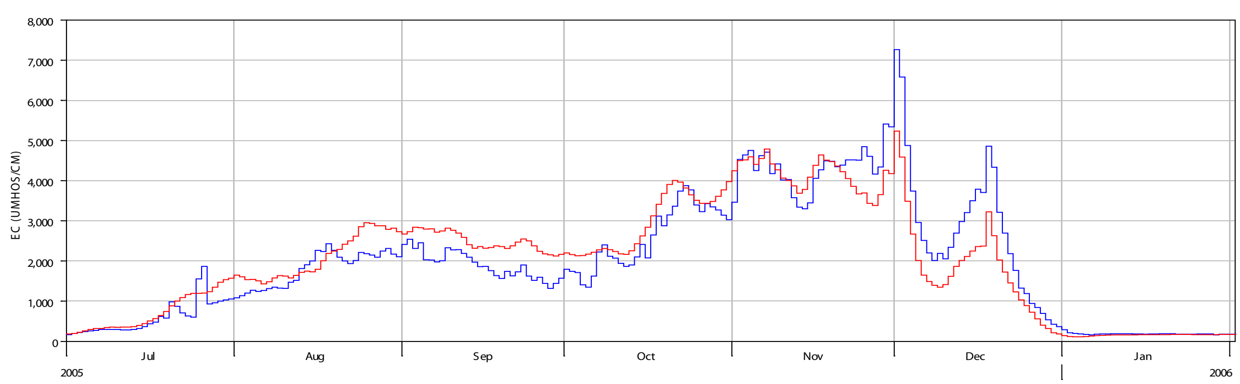


Figure 8. Comparison of EC at Clifton Court, Jersey Point, and Antioch in 2005.

2. Observed EC at Clifton Court Forebay gates and model predicted EC, which is average EC of the reservoir, are not exactly the same thing. There is a subtle difference between these two, as shown in Figure 9 for a short time period. EC at the gates fluctuate much more than the averaged EC of the reservoir. Time average EC at the gates is not exactly EC in the reservoir. Observed EC at Banks Pumping Plant (HBP) represents EC in the reservoir better, so we used observed EC at HBP to compare with modeled EC at the reservoir.

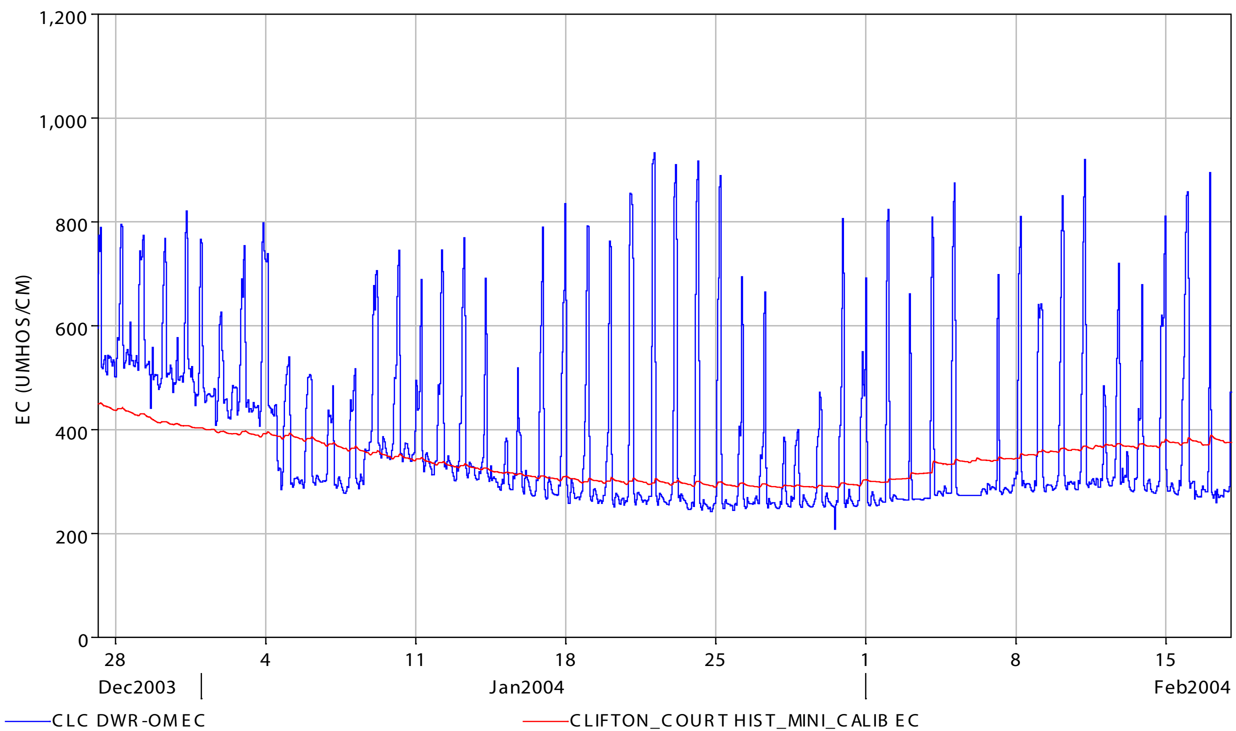


Figure 9. Comparison of observed EC at Clifton Court gates and simulated EC

Summary

This limited Version 8.1 calibration improved the results based on 2009 calibration. Trial runs to fine-tune the dispersion coefficients gave little improvement. It is obvious most of the large errors in the calibration cannot be corrected by adjusting dispersion coefficient. All the runs (including Hydro, Qual) used 5 minute time steps. A test run with 15 minute time steps showed negligible differences in most of the stations and small differences in a few stations. 5 minute time step is recommended for higher accuracy. The tide files used 15 minute time step instead of 1 hour used in previous calibrations and studies. The model still has a lot of limitations in predicting accurate EC over the Delta. A more accurate full calibration and maybe improvements to the model itself are highly desirable.

References

Lianwu Liu and Eli Ateljevich, Improvements to the DSM2-Qual Part 1, *Methodology for Flow and Salinity Estimates in the Sacramento-San Joaquin Delta and Suisun Marsh, 32nd Annual Progress Report, June 2011.*

CH2M Hill, *DSM2 Recalibration,* Prepared for California Department of Water Resources, October 2009.

DSM2 VISTA Update

Nicky Sandhu, Senior Engineer WR, DWR

VISTA is a time series manipulation and plotting tool that is used for pre-processing and post-processing tasks in DSM2. An older version was packaged with DSM2 v8.

VISTA has gone through several improvements over the last couple of years. The latest version is available http://code.google.com/p/dsm2-vista/ and the latest source code is hosted on code.google.com/svn in keeping with our open source principles.

The major changes are:

1. Ability to read DSM2 Hydro tidefile. The tidefile contains the flow, stage and area information output from DSM2 Hydro and is mainly used for transferring this information for the DSM2 Qual run. This information can be read by VISTA and is displayed as time series for flow, stage, area and volume for every channel and reservoir.

2. Enhanced merging functionality using flagged data. VISTA has had the ability to flag data as questionable, reject or good. For many locations, there may be multiple time series from various sources available that are of varying quality. VISTA has the ability to merge these time series as long as they have the same time interval.

3. Added ability to export DSS data without flags by converting the reject and questionable data to -901.0 (MISSING VALUE as per HEC-DSS conventions)

4. Jython script based applications packaged with Vista

    a. DSS Output compare tool

    b. PTM Dual Animator. This tool reads PTM output files to display an animation of particles as squares on a DSM2 channel grid outline.

Sediment Transport Module Update

Jamie Anderson, Senior Engineer WR, DWR

Researchers from the University of California at Davis have been working with Delta Modeling staff over the past 2 ½ years to develop a new general transport module for DSM2 that includes sediment transport as a particular constituent. The new module is called STM for Sediment Transport Module. The contract for this project ended in June 2011, so this article highlights accomplishments of the STM project to date:

- Developed 1-D transport code for a single channel
- Developed extensive suite of nearly 350 tests to verify the code
- Developed sediment transport routines for entrainment and deposition
- Developed website of available sediment transport data.

The development was guided by a Technical Advisory Committee. STM aims for second order accuracy in its numerical solution. STM was developed using operator splitting which involves the sequential solution of the processes involved. For advection, a second-order Lax two step method was implemented. A centered in time, second-order scheme was used for dispersion. The reaction portion, in turn, was coded using diverse approaches.

STM was developed using principles of both fluid mechanics and computer science to create a testable and well verified transport code (Figure 1). We believe this is the best tested one-dimensional transport code that has ever been developed. Since there was little guidance available in the literature on how to do this type of testing, most of the project's effort was spent on the code tests. STM currently has approximately 350 tests, with approximately 280 unit tests and 70 transport algorithm tests. The unit tests verify that each piece of code performs the function that it was designed to do. The transport algorithm tests then verifies that the collection of code pieces properly represents the transport processes of advection, dispersion and reaction (sources/sinks) (Figure 2). The three transport processes are tested individually and in various combinations of increasing complexity. Although some of the tests used to verify the transport code were available in the literature, many of the tests were developed by the STM team. Thus this project produced two sets of code, one for the transport module and one for the tests. The tests can be run at any time to verify that the code is working properly and to make sure that any changes to the code have not caused unexpected problems.

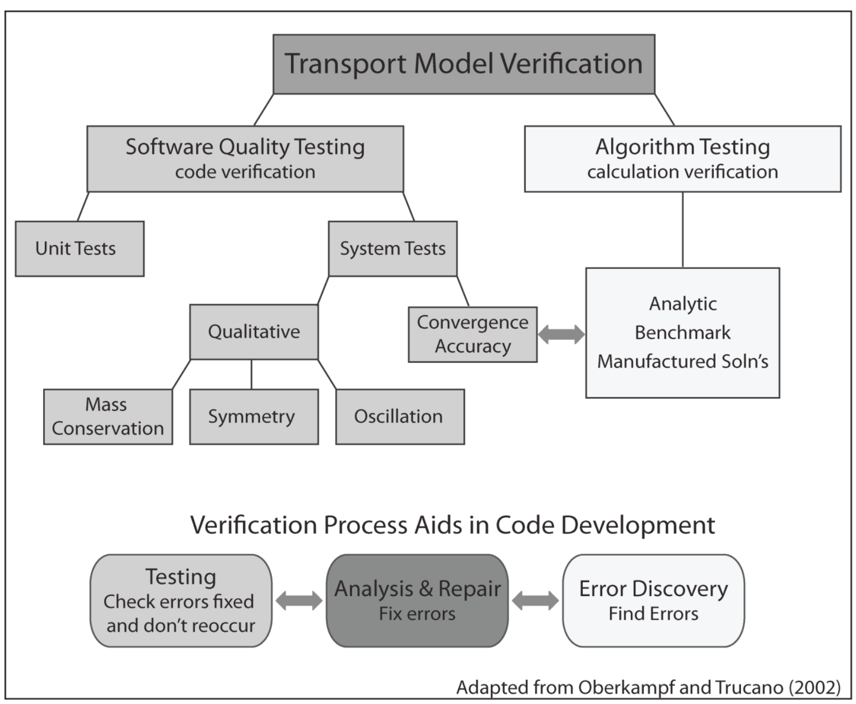


Figure 1. Relationship between software testing components and algorithmic testing.

Passing such a rigorous suite of tests builds confidence in both developers and users. Since this work is so innovative, it has been presented at the California Water and Environmental Modeling Forum in February 2011 and written up as a conference paper and presented at the American Society of Civil Engineers conference in Palm Springs in May 2011. Journal papers are also being prepared.

Once the transport foundation had been established, progress was made on routines for sediment transport. The sediment transport library aims to represent both suspended load and bed load for non-cohesive and cohesive sediments. The library automatically categorizes sediment particles either as suspended load or bed load, and is able to handle several sediment size classes. Then, it simulates deposition, entrainment, and movement of cohesive and non-cohesive sediment in the channel. The first two sediment processes are represented by empirical relationships from the literature. The user will have multiple formulations to choose from when running the model.

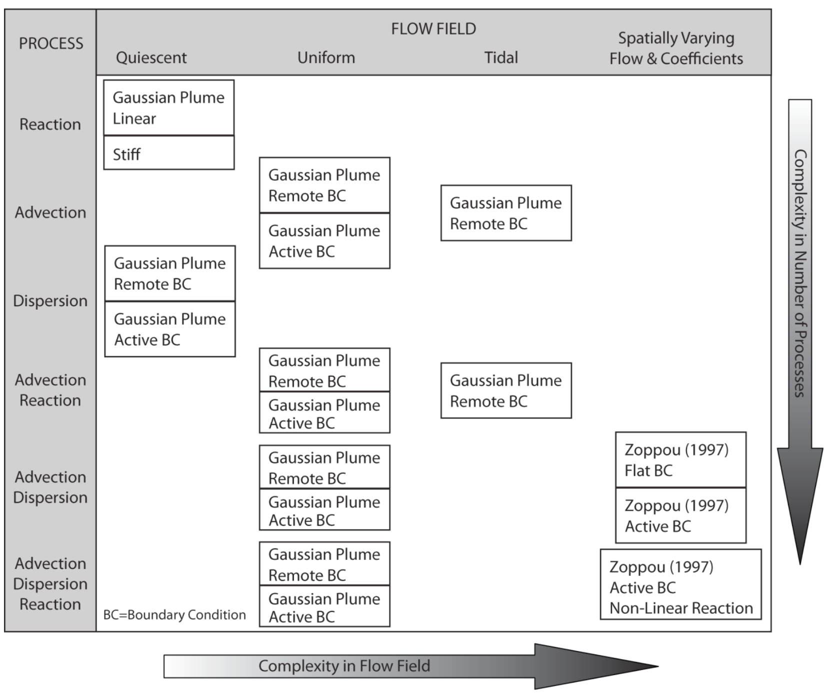


Figure 2. Transport algorithm testing with incremental complexity.

Special thanks to Eli Ateljevich of DWR (technical guidance, programmer) and to Kaveh Zamani of UC Davis (graduate student researcher, programmer) for their dedicated efforts on this project. For further information please contact Fabian Bombardelli at UC Davis at fabombardelli@ucdavis.edu or Jamie Anderson at DWR at jamiea@water.ca.gov.

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DSM2 Calibration Update

Ralph Finch, Senior Engineer WR, DWR

Observed Data Checking

Clearly observed (historic) time series data of stage, flow, and water quality is critical for calibration of DSM2. Unfortunately there is no single source of good quality data for the Delta. Several sources are available which have different levels of data quality, record lengths, and types of data. The Delta Modeling Section is continuing to gather data from known sources, check and flag it, and combine and process multiple data streams of the same type and location into a single, “accepted” data stream for each type and location.

Monitoring Station Locations

Along with the time series data itself, the horizontal location of the monitoring stations must be known to within a few meters. This is needed both to locate DSM2 channel junctions correctly and to place the monitoring stations correctly within the DSM2 grid. As with the time series data, there is not a single source of station location data that is known, at this time, to be correct. The Delta Modeling Section has obtained several lists of station locations from different sources, but the sources differ in their placement of stations. To check the sources, Section personnel measured several station locations with a handheld GPS device, and will check those known correct results with the lists in hand. Lists which compare satisfactorily will be assumed accurate for other, unchecked stations. It is anticipated that at least one more field trip will be necessary to spot-check more stations.

Sensitivity Testing

Sensitivity testing is one of several tasks needed before a full re-calibration of DSM2 can take place. Sensitivity testing measures the sensitivity of DSM2 output—in particular, flow and water quality calculations—to unit changes in input parameters. The two traditional calibration input parameters, channel friction and dispersion coefficients, are tested, as well as inputs which are known to have imprecise values (channel average cross-sections, consumptive use, and island return flow water quality).

Sensitivity testing can tell us several things. First, it can show which input parameters have greater influence on output, i.e., which control knob is more powerful. For example, is channel friction or dispersion more important in affecting EC output? Second, which channels or diversion nodes have the greatest influence within a given parameter? Does the relative sensitivity of neighboring channels or nodes make sense? For instance, if one channel’s friction coefficient affects output several times as much as an adjacent channel, does that indicate an error in the geometry of the channel grids?

Results of a sensitivity test pilot study of DSM2 was reported on the April 28, 2010 meeting of the DSM2 Users Group. Work continues to move from a pilot study to production sensitivity tests. A huge amount of data must be generated, and then condensed to make sense of it. For example, testing the sensitivity of all channels’ Manning’s N value entails over 500 DSM2 Hydro and Qual runs of one year each (starting from a previous warm-up run), generating output at 70 output locations throughout the Delta and Suisun Marsh. Each additional input parameter, and each different tested time period, requires many more such sets of runs.
To perform the runs, the Delta Modeling Section executes DSM2 in parallel over about 15 different computers in the Section, each with 4 CPU cores, using Condor from the University of Wisconsin. Results from each individual run are stored in a 1-year DSS file. After each set of runs is finished, a VScript program is run, averaging EC values or peak-to-trough measures for flow using the last 28 days of each run. These greatly condensed results are stored in an Access relational database where they are further processed with SQL queries to produce maps with colored channels or nodes indicating relative sensitivity of the given output location to changes in the channels’ or nodes’ input parameter. Investigations are being performed now to see whether ESRI ArcMap or Google Maps is preferred for producing the maps.

CSDP and DSM2 Grid Map

Nicky Sandhu, Senior Engineer WR, DWR

CSDP is the cross section development program developed by Brad Tom to create and view cross sections using bathymetry data.

DSM2 Grid Map is an online Google Maps based viewer for spatial information about DSM2 model. DSM2 Grid Map allows one to view the cross sections and other information about the DSM2 model network using just their web browser. CSDP website (http://baydeltaoffice.water.ca.gov/modeling/deltamodeling/models/csdp/csdp.cfm) has been updated with the latest files for the 2000 calibration and 2009 calibration. These files were converted to DSM2 Grid Map format and uploaded to the site. This information is shared so that anyone with a browser can now look up this spatial information by simply clicking on the links provided and viewing the cross sections and channel outlines in a browser (see Figure 1).

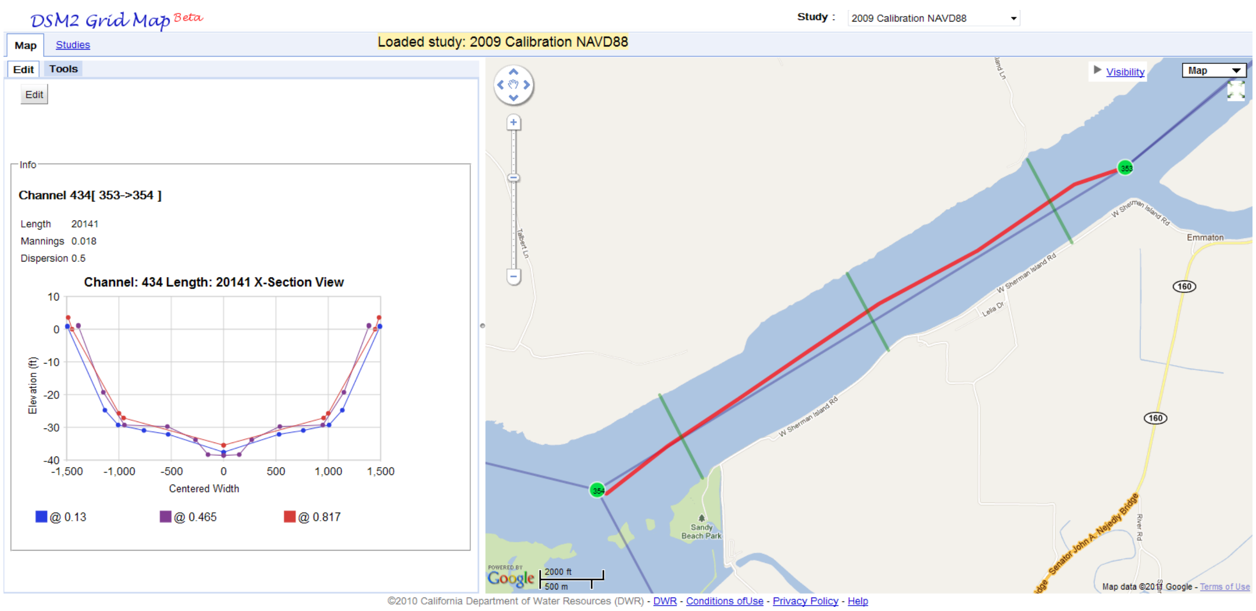

Figure 1

DSM2UG People

There is Something About Marianne

Min Yu, Senior Engineer WR, DWR

When Marianne Guerin first received her technical degree in Electron Microscopy, she didn't know that someday she would have a successful career in the water resources computer modeling field. After working for Hewlett-Packard a few years, Marianne felt there was a need to further her study. She went back to school and attended Humboldt State University, majoring in Environmental Engineering. Not for long! Marianne switched to math, believing that a strong background in math and science would ensure entry into any field. Marianne went on to obtain a BS degree in math from Humboldt State, and MA and PhD degrees in math from the University of Maryland.

Marianne and Princess getting ready for flight

During the last year of her PhD program, Marianne moved to Australia with her former husband. She landed positions which gave her a first taste of the computer modeling: for two years she performed economic and health care modeling. Then for six years she worked for the Australian Nuclear Science Technology Organization (ANSTO). At ANSTO, Marianne developed a multi-component reactive transport model. The complexity and demands of her work made Marianne feel like she was undertaking another PhD program while she was still finishing hers. Fortunately, strong backgrounds in science and math did come to her rescue; however, completing this project still took Marianne five years. No wonder she considers it the greatest challenge of her career.

Marianne returned to the U.S. after her 'gig' at ANSTO. She moved around and worked at LBNL, the University of Georgia, and Contra Costa Water District before she settled into her current position as a Senior Water Resources Specialist with Resource Management Associates (RMA). Marianne has been utilizing both RMA and DSM2 models to assess a variety of water quality and fishery issues facing the Delta. Most of her recent work focuses on nutrient modeling and turbidity forecasting modeling, and she has been working closely with Paul Hutton from MWD.

In her spare time, Marianne enjoys gardening and wine collecting. She has redesigned her backyard into an English Country garden, but with plants suited to the California climate. Her top two favorite wine varieties are very dry Rieslings from Australia and Pinot Noir from Oregon. Nevertheless, Marianne's real passion is gliding. She received her glider pilot license just a year ago. Since she purchased a sailplane last November, Marianne has been flying whenever the weather allows. So if you are ever driving on Interstate 5 and see a sailplane circling above, it just might be Marianne surveying the Delta and trying to collect some data for her next project.

Parviz Nader-Tehrani
20 Things You Don't Know About Me

Min Yu, Senior Engineer WR, DWR

Parviz, a Supervising Engineer with the Delta Conveyance Branch (BDO, DWR), shares with us 20 tidbits about himself.

1. I first wanted to be an engineer when I was only 6 years old. I briefly became enamored as a teenager with the idea of becoming a pilot because I loved traveling, but that interest didn't last long. By the time I entered high school, I once again felt that being an engineer was my true calling.
2. I looked up to my dad when I was growing up. He was a Transportation Engineer and definitely a 'do-er'.
3. When I was in elementary school, I considered myself to be an outstanding student because I was the ONLY student who received prizes from the Principal at the end of every school year. Only much later did I found out that those prizes were actually given by my mom.
4. There are three scientists who I have admired the most: Einstein, Galileo, and Darwin.
5. My education background wasn't in the field of water resources engineering. I received my Ph.D degree in Structural Engineering from UC Davis, and I started my career as a Bridge Designer at Imbsen &Associates in Sacramento.
6. I met my future wife when I was 21 and pursing a Bachelor of Science degree in Civil Engineering at CSU Fresno. I guess you can call us college sweethearts.
7. My favorite teacher in college was Professor Chang from Fresno State, who once said, "The best way to learn something is to teach it." Since I started teaching part-time at UC Davis, I have realized that Professor Chang was absolutely right!
8. I have lived in Davis ever since moving there in 1982.
9. I'm not much into electronic gadgets. I still use a very simple cell phone and just learned how to text recently.
10. In my 20+ years career with DWR, I have completed a great number of assignments. Among all the projects that I have worked on, the most satisfying one was my involvement in the Three-Mile Slough project. It all started with an intuitive idea, but it became the Preferred Project Alternative for the Franks Tract Project. Based on the modeling study analysis, the Three-Mile Slough project could significantly improve Delta water quality and also offer fishery benefits as well.
11. I love movies. This passion started when I was in 8th grade. Back then, I watched movies every Thursday night after school. Nowadays, I don't go to movie theaters often, but I am a big fan of Netflix and I watch as many as time allows.
12. One of my hobbies is photography. I once took 450 pictures for a 3-day trip.
13. My favorite TV series when I was a teenager was Lost in Space. My favorite movie of all times is an Italian movie called Cinema Paridisio.
14. Because of my daughter's influence, my choice for music has expanded. Even though I am still a fan of the songs from the 1980s and 90s, I do listen to Lady Gaga's more often than I will admit to.
15. Speaking of my daughter, I am very proud of her. She is in high school, and we are very close. The best part of our relationship is that I can trust her and she knows that.
16. I don't usually eat out, but I do have a favorite restaurant which I like to visit often. It is an Italian restaurant in the Bay Area, called 'Stinking Rose'. The name must be closely related to how generously garlic is used in every dish.
17. My favorite software is Google Earth. I am somewhat a 'virtual tourist' and I enjoy using this tool and traveling far and away right in front of my computer.
18. I do love traveling and I have taken several cruises. The cruise I most enjoyed was to Alaska.
19. My preferred mode of traveling is by car. I love to take four to five days to drive to a place and do some sightseeing. I am very much into nature.
20. Speaking of Alaska, one of the three main things listed on my Bucket List is to drive to Alaska someday. The other two things I would like to accomplish in life are having a trip around the world and volunteering at nursing homes after I retire.

Ralph’s Garage Project

Ralph Finch, Senior Engineer WR, DWR
Min Yu, Senior Engineer WR, DWR

Delta modeling and aviation have a history beginning with Dr. Hugo Fischer, the pioneer of numerical modeling in the Sacramento-San Joaquin Delta. Dr. Fischer was an avid glider pilot and flew sailplanes in competitions.

Dr. Marianne Guerin of RMA is also a sailplane pilot (see this issue). Wim Kimmerer, Research Professor at San Francisco State University and well known in the Delta community, owns an airplane and has flown it to the Monterey airport to attend the IEP/CWEMF annual meetings at Asilomar. Another Delta modeler who is a long-time pilot is Ralph Finch of the California Dept. of Water Resources, Delta Modeling Section. Ralph soloed on his last day as a teenager and got his license in powered aircraft on the 199 th anniversary of the United States, while still in college. After obtaining his license he stopped flying for a number of years, but resumed his favorite pastime more than 15 years ago. For a while he was in a flying club, which offered a variety of different aircraft to fly, and the convenience of doing all the maintenance and repairs. Furthermore the club was just 3 miles from his house. But the club and Ralph moved away from each other and what was a 10 minute drive turned to an hour each way. Ralph knew he wasn’t getting enough flying time to keep in practice; it was either quit flying or get more involved. He decided to buy a small airplane and keep it at a local airport in Davis. With that airplane he has flown to Southern California, Arizona, Washington State, and Wisconsin, where the world’s largest fly-in/airshow is held one a year.

He still has that airplane, an Aircoupe. But 3 years ago he wanted something with better performance to make longer flights easier. A factory built airplane with good performance (cruise speed of 180 mph), even a used one, would be expensive, but homebuilt, experimental airplanes offered superior performance and a more affordable price tag. So he bought a kit plane called an RV-9A from Vans Aircraft and started to build it.

Ralph says he enjoys working with his hands and seeing something gradually take form. Most of the work is done by him, and there is satisfaction in being responsible for something which will have real consequences. “At work, most things are abstract, and any consequences, if any, are far in the future. But building an airplane will ultimately have life or death consequences, a real contrast to most of what I do.”

Ralph hasn’t given a time-frame for when it will be complete, but hopes in a few years to be making flights in an airplane custom-built for himself.

Survey of Structures and Scour in Areas Of Moderate Inundation After the 2011 Tohoku Tsunami

Jeremy Bricker, Coastal & Water Resources Engineer, URS Corp.

The Great Tohoku Tsunami struck the northeast coast of Japan on March 11, 2011, approximately 40 minutes after a historic magnitude 9.0 earthquake 130 km east of Sendai. Iwate, Miyagi, and northern Fukushima prefectures (left side of Figure 1) were devastated by inundation up to 40 m above the undisturbed sea level, while Aomori, Chiba, Ibaraki, and southern Fukushima prefectures (right side of Figure 1) were subject to tsunami wave amplitudes of between 2 m and 10 m. Since the inundation depths expected from the maximum credible tsunami in the heavily populated and developed regions of the San Francisco Bay area are up to 10 m (Borrero et al, 2006), a survey was carried out from April 30 to May 2, 2011 to detail the response of coastal structures to the event in Chiba, Ibaraki, and southern Fukushima prefectures. Lessons learned from these locations will help to plan for the design-level event in the San Francisco Bay area.

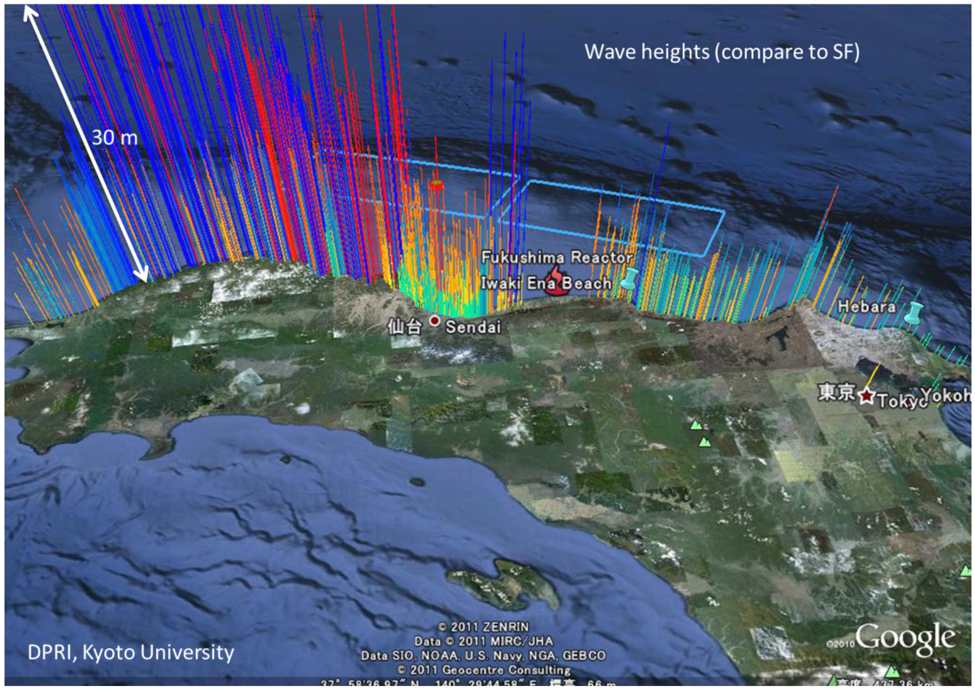

Figure 1. Runup heights on the east coast of Japan from the Great Tohoku Tsunami of 2011.

One of the main mechanisms of coastal structure failure was observed to be scour of the soils supporting those structures, and measurement of scour depths was one of our team's objectives. Scour at the toes of seawalls, floodwalls, and quay walls caused those walls to slump, resulting in further scour of the fill behind the walls. Scour at building foundation footings also caused collapse of buildings in some cases. The ability to predict scour depth is important in order to design these structures to survive a tsunami, especially if they are essential infrastructure for the restoration of lifelines after a disaster, or if they must be designed for life safety (as in the case of structures meant for vertical evacuation).

In addition to me, the team had two members. Mathew Francis, a geotechnical engineer from URS and an official delegate of the American Society of Civil Engineers to Japan, lead the team. Professor Akihiko Nakayama, from the Civil Engineering department of Kobe University and member of the Japan Society of Civil Engineers, managed much of the logistics of the survey and brought expertise in fluid mechanics to the team.

One of our measurement sites, Iioka, exhibited floodwall failure along a river (Figure 2). The tsunami propagated up the river, overtopped the banks, and caused scour of the land at the toe of the floodwall (Figure 3). During the retreat of the flood, water plunged back into the river over the floodwall, causing similar scour at the waterside toe of the wall. When this waterside toe scour became too deep, the wall slumped into the river as shown in Figure 2, leading the buildings behind the floodwall to slide into the river as well.

Figure 4 shows a similar type of damage. During tsunami drawdown, water plunged over the quay wall at Kashima port. The scour hole resulting at the toe of the wall caused the wall to slump. This was followed by erosion of the earthen fill behind the quay wall, and subsequent failure of the asphalt deck atop the earthen fill.

Along the Nagasaki coastline, two types of seawall failure were observed. Figure 5 shows a seawall that has slumped downward. This was caused by the development of a scour hole on the landward side of the seawall when the flood overtopped the wall. Figure 6 shows a seawall that toppled in the seaward direction. This occurred during the retreating tsunami, as the pressure difference due to higher water level on the landside of the wall than on the seaside, along with the speed of the retreating current impinging on the landside crest of the wall, pushed it seaward.

Also along the Nagasaki coastline, Figure 7 shows the damage typical in Iwaki City. Many wooden structures were demolished by the tsunami. Steel-frame structures and heavy wood-frame structures had their walls and windows blown out, though the frames survived as they became flow-through; the upper floors of these structures were intact. Reinforced concrete structures survived mostly intact, though some lost windows and doors.

Figure 2. Slumped floodwall at Iioka, Asahi City, Chiba Prefecture.

Figure 3. Scour behind floodwall at Iioka, Asahi City, Chiba Prefecture.

Figure 4. Failed quay wall at Kashima Port, Ibaraki Prefecture.

Figure 5. Scour hole and slumped seawall at Nagasaki coast, Iwaki City, Fukushima Prefecture.

Figure 6. Toppled seawall at Nagasaki coast, Iwaki City, Fukushima Prefecture.

Figure 7. Collapsed structures at Nagasaki coast, Iwaki City, Fukushima Prefecture.

DSM2UG News

DSM2UG Logo

Seven years after it was launched in January 2004, DSM2UG finally has its own logo. A total of 42 votes were received. Logo #5 was the final selection and logo #4 was a close second. Thank you all for your participation and support! We are looking forward to another seven years of healthy growth of the group!

DSM2UG is on Facebook

DSM2UG is now on Facebook. To get the latest updates on DSM2 applications and development, or initiate/participate in a discussion on DSM2 related topics, please visit our Facebook page (https://www.facebook.com/pages/DSM2-User-Group/259788977380676).

If you have any questions or comments regarding this issue of the newsletter, please contact the facilitator of the DSM2 User Group:

Min Yu, P.E.
Senior Engineer
Delta Modeling Section
Bay-Delta Office
Department of Water Resources
1416 9th Street
Sacramento, CA 95814

Email: *minyu@water.ca.gov*
Phone: (916) 653-5225

This newsletter can be accessed at the DSM2 User Group website:
http://baydeltaoffice.water.ca.gov/modeling/deltamodeling/dsm2usersgroup.cfm